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1 Safety

1.1 Safety labels
The following safety labels relating to the operation of the TAPCON® 250 are used in these operating instructions. These labels must be observed at all times!

<table>
<thead>
<tr>
<th>DANGER!</th>
<th>WARNING!</th>
<th>CAUTION!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refers to an imminent danger that may result in death or severe injury.</td>
<td>Refers to a potentially hazardous situation that may result in death or severe injury.</td>
<td>Refers to a potentially hazardous situation that may result in slight injury or material damage.</td>
</tr>
</tbody>
</table>

NOTE!
Contains important information and special notes.

The following specific safety warnings are used in these operating instructions:

| Risk of electric shock! | Fire hazard! |

1.2 Safety instructions

- All warnings and safety instructions must be observed at all times!
  Danger of death and risk of injury! Not following the safety instructions may lead to accidents and severe personal injury.
  
- Please read these operating instructions before commissioning the equipment!
  Read the operating instructions before commissioning the TAPCON® 250.
  As operator, you are responsible for ensuring that users of the equipment have fully understood the operating and safety instructions.

- Always connect the TAPCON® 250 to an electrical ground!
  To avoid shock hazard, the chassis must be connected to an electrical ground. When servicing the TAPCON® 250 in a test area, the protective earth terminal must be attached to a separate ground securely by use of a tool since it is not grounded by external connectors.
• Only suitably qualified personnel should work at the TAPCON® 250!

The TAPCON® 250 contains high voltages which can cause serious injury or death! It is designed exclusively for application in electrical or energy systems and facilities operated by appropriately trained staff who are familiar with the installation, operation and maintenance of such products. Exercise due care when operating or servicing alone.

• Do not operate the TAPCON® 250 in an explosive environment!

Do not operate this equipment in the presence of flammable or explosive gases or fumes. To do so would risk a possible fire or explosion.

• Keep away from live circuits!

Operating personnel must not remove the cover or expose the printed circuit board while power is applied. Dangerous voltages may exist even when power is disconnected. To avoid electrical shock, always disconnect power and discharge circuits before working on the unit.

• Do not modify the TAPCON® 250!

Do not perform any unauthorized changes on the TAPCON® 250. Contact Reinhausen Manufacturing regarding any modification. If authorized modifications are to be attempted, be sure to follow replacement procedures carefully to assure that safety features are maintained.

• Avoid static charge!

The TAPCON® 250 contains MOS circuitry which can be damaged by improper test or rework procedures. Avoid static charge on work surfaces and service personnel.

• Use extreme caution during any diagnostic work!

Any attempt to perform any diagnostic work or connection between points on the printed circuit board, unless services noted in the Operating Instructions is likely to cause damage or permanent failure to the TAPCON® 250.
2 General

2.1 Foreword
These operating instructions relate to the TC250-80 adapter panel for Reinhausen’s voltage controller TAPCON® 250. They describe the necessary connections for electronic voltage regulation of tap changers in power transformers.
Please read these instructions before commissioning the TC250-80 adapter panel together with the TAPCON® 250. The operator is responsible for ensuring that users of the device have fully understood the operating and safety instructions.
More comprehensive information about the configuration and operating principle of the voltage controller along with settings for special applications can be found in the following document: Operating instructions BA297 “Digital On-Load Tap Changer Voltage Controller TAPCON® 250”.

2.2 Manufacturer
The voltage controller TAPCON® 250 is manufactured by:
Reinhausen Manufacturing Inc.
2549 North 9th Avenue
Humboldt, Tennessee 38343, USA
Phone: (+1)731/784-7681
Fax: (+1)731/784-7682
Email: reinhausen@bestltc.com

Further copies of these operating instructions are available from the above address, if required.

2.3 Warranty and Liability
Warranty and liability claims for personal injury or damage to property are excluded, if they were caused by one or more of the following:
• Inappropriate use of the TC250-80.
• Improper commissioning and operation of the TC250-80.
• Operation of the TC250-80 with safety equipment that is faulty, or with safety or protection equipment that is installed incorrectly or non-functioning.
• Non-adherence to the notes in the operating instructions with regard to installation, commissioning and operation of the TC250-80.
• Unauthorized modification of the TC250-80.

The adapter panel TC250-80 is offered with an extended warranty.

2.4 Specified Application
An adapter panel or a surface mounting kit must be used with the TAPCON® 250. Each panel adapts the TAPCON® 250 as a transformer control replacement and provides the external connections necessary for operation via terminal blocks on the rear of the adapter panel.
The adapter panel TC250-80 in combination with the TAPCON® 250 voltage controller is used for automatic control of transformers with motor-driven tap-changers. The motordrive mechanism receives the corresponding control signals from the voltage controller. With these signals, the tap-changer moves to the next position and the transformer’s voltage value is adapted to the preset reference voltage level.
The TC250-80 is a general purpose adapter panel designed for mounting in new or existing control schemes. If used as a replacement for a chassis mounted controller such as General Electric static LTC static transformer and regulator controls and some balance beam models, Reinhausen’s TC250-80 chassis should also be used.
Otherwise, the TC250-80 panel can be surface mounted as a general purpose adapter panel or as a replacement of Beckwith M-0270 and M-2270 models.
The 12.5” x 13.9” adapter panel with its chassis mounts via four ¼” - 20 x 1” studs located on the chassis.
If the panel alone is used for surface mounting, four 13/64” holes are also available along with mounting hardware.

Figure 1 General Electric Voltage Regulator
For further information on
• TAPCON®250
• Analog Input/Output Module
• Communication interface card
• Adapter Panels
please contact Reinhausen Manufacturing or www.tapcon250.com.
2.5 Features of the TC250-80 Adapter Panel

The TC250-80 adapter panel comes equipped with the following standard features:

- A voltage input fuse block with a 300 mA fuse (and a spare fuse in the fuse holder) to protect the controller's input.
- A motor power input fuse block with a 6 A fuse (and a spare fuse in the fuse holder) to protect the controller’s input.
- Voltage Test Terminal (VTT) binding posts.

Optional/Application Specific Features:

- LOCAL/REMOTE selector switch
- AUTO/MANUAL selector switch
- MANUAL LOWER-OFF-RAISE momentary selector switch
- PARALLEL/INDEPENDENT selector switch
- DRAG HANDS RESET switch

**NOTE!**

Do not apply voltage at these terminals. This is only a measuring point.

- Voltage Input binding posts. These are used for powering the controller’s voltage input (P2.1 and P2.3) with 85 to 140 VAC (45...65 Hz) when the panel is in EXTERNAL mode.
- Motor Power binding posts. These are used for powering the controller’s motor power input (P2.8 and P2.3) with a maximum of 240 VAC when the panel is in EXTERNAL mode.
- INTERNAL/EXTERNAL selector switch for selecting the panel's voltage and motor power inputs.
3 Commissioning

3.1 Removal of Old Controller

1) Remove voltage from N1 (10) and N4 (9) of the existing controller.
2) Short the CT primary or secondary that supplies and returns current at N3 (14) and N2 (15).
3) Remove any and all wetting voltage supplies from the wiring harness since they should not be reused for the TC250-80 adapter plate.
4) Ensure that all remaining wires are de-energized and then remove the wires.
5) Remove all rear mounted nuts and any bottom mounted nuts from the existing controller. Surface mounted applications usually require the removal of four bolts located on the face of the panel.
6) Remove the old controller from the cabinet.

3.2 Installation of TC250-80 Adapter Panel

Refer to the appendix for dimensions of the adapter panel and any other necessary control cabinet preparation. Mount the TAPCON® 250 voltage controller to the back of the adapter panel TC250-80 door.

For rear-mounted chassis retrofits:
Secure the chassis with the four washers, lock washers, and 1/4"-20 nuts provided. For bottom-mounted chassis retrofits, secure the bottom rear of the chassis with the two washers, lock washers, and 3/8"-16 x 1" nuts saved from the existing chassis and then repeat with any fasteners used to mount the base of the chassis. Slide the TC250-80 door onto the lift-off hinge pins and insert the two plugs from the adapter panel into the connector at the bottom of the TAPCON®250.

For surface mounting applications:
A 10.5" x 12" cutout is needed along with four 13/64" (minimum) diameter holes. Correspondingly, four 13/64" diameter holes located towards the edges of the TC250-80 panel are available for use. Use the supplied hardware to surface mount the panel.

3.3 Connection

Connect the voltage controller and adapter panel in accordance with the correct wiring diagram variation (see chapter 4.5, 4.6, 4.7 and 4.8) and according to the wiring diagram of the respective motor drive. In general, the voltage controller is operated by the measurement voltage of 85..140 VAC on pin P2.1 (Line) and pin P2.3 (Neutral). The controller accepts 0.2 A rated line current on pin P2.4 and P2.2.

If a chassis is used, the TB1 terminal block connections should be made with a #12 - #18 AWG copper wire in a TYCO/AMP 320619 type (or equivalent) ring tongue terminal and 16.0 lb-in tightening torque.

Any direct connections made to supplied selector switches must be with a #14 - #16 AWG copper wire in a TYCO/AMP 52935 type (or equivalent) terminal. Direct connections to the TAPCON® 250 terminal connections P1, P2 and P3 should be made with a #12 - #24 AWG copper wire preferably in a TYCO/AMP #131331 type (or equivalent) ferrule and 4.5 lb in tightening torque.

The voltage controller alternatively accepts an external +12 VDC/1A power supply on terminal P3 (P3.1 = polarity, P3.2 = return) for continuous operation during an AC power outage.

The TAPCON® 250 was developed in compliance with the relevant EMC standards. The following instructions must be observed to ensure preservation of the EMC properties:

- Ensure proper grounding of the TAPCON® 250 by means of the chassis ground screw attached to the housing.
- Be sure to use only shielded cables for the data links from the TAPCON® 250 to other equipment.
- Refer to the Operating Instructions BA 297 provided separately for wiring details if needed.

**NOTE!**

1. Ensure that removal instructions assume a chassis mounted application. M-0270 connections are shown in parenthesis.
2. Remove voltage from N1 (10) and N4 (9) of the existing controller.
3. Short the CT primary or secondary that supplies and returns current at N3 (14) and N2 (15).
4. Remove any and all wetting voltage supplies from the wiring harness since they should not be reused for the TC250-80 adapter plate.
5. Ensure that all remaining wires are de-energized and then remove the wires.
6. Remove all rear mounted nuts and any bottom mounted nuts from the existing controller. Surface mounted applications usually require the removal of four bolts located on the face of the panel.
7. Remove the old controller from the cabinet.

**WARNING!**

Risk of electric shock!
Ensure that the voltage controller is connected and the housing grounded with due care.

**NOTE!**

Pay attention to the correct phase angle of the secondary terminals of current transformer and voltage transformer. Ensure correct connection of the output relays to the motor drive unit.
3.4 External Connections

**Pin TB1.1 Voltage Input**

This input accepts nominal 120 VAC, 45...65 Hz to operate the control's power supply and voltage sensing input. The acceptable voltage range for proper control operation is from 85-140 VAC. Power consumption is 6 VA to 12 VA depending on the amount of extensions. The input voltage is referenced to line neutral (Pin TB1.6). When the INTERNAL/EXTERNAL switch is in the INTERNAL position, voltage is supplied to the controller from the potential transformer and the VTT binding posts are to be used strictly as a measuring point.

**Pin TB1.2 Load Current Return**

This is the non-polarity input to the load current measuring transformer. The companion polarity input is Pin TB1.3. The line current transformer input is isolated from other pins.

**Pin TB1.3 Load Current Polarity**

The line current input range is 0-420 mA (200 mA continuous) with 200 mA representing the 1.0 per unit value. The measured current value is used for line drop compensation and metering calculation.

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**NOTE!**

The following connections are for applications that require a chassis.

If a chassis is not used, connections must be made directly to the TAPCON® 250 regulator or pre-wired selector switches. Refer to the LTC motor drive wiring schematic and use the wiring variations located in the appendix as references.

If a chassis is not used, the TB1 connections are the only omissions from the wiring variations in the appendix.

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**WARNING!**

**Risk of electric shock!**

The current input to the TAPCON® 250 is rated at 200 mA continuous, 420 mA for two hours, and 4.0 A for 1 second. If the TC250-80 chassis is not used, then automatic CT shorting is not pre-wired, but a pair of shorting diodes is provided that can be applied by the installer across the 200 mA CT secondary.

**Pin TB1.4 Motor Power Input**

The source for powering the tap-changer motor (and thus for the raise and lower circuits) is connected here. It may have a maximum voltage of 240 VAC.

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**NOTE!**

This terminal is internally connected to the MANUAL/AUTO (P2.26) and LOCAL/REMOTE (P2.27) switches of the TC250-80 panel.

If equipped with the LOCAL/REMOTE selector, motor power at TB1.4 will enter the on-board LOCAL/REMOTE switch.

If the switch is in LOCAL position, then the panel and controller can be operated locally via automatic or manual operation.

If the controller is set to remote, then the user can completely control the TAPCON® 250 via the optional communications interface.

Otherwise, the remote input can be used as a status indication.
Pin TB1.5 Alternate Voltage Level #3
This digital input is typically enabled by connecting it to the nominal +12 VDC wetting source (Pin TB1.9), through an external dry contact. The amount of alternate voltage is determined by the setting in the Parameter => Regulation Param. menu.

**NOTE!**

Enabling both alternate voltage levels #2 and #3 inputs simultaneously will result in the level of alternate voltage as specified on the alternate voltage #4 setting in the Parameter => Regulation menu.

Pin TB1.6 Neutral
This is the return for the Voltage Input (Pin TB1.1), and nominal +12 VDC "wetting" voltage (Pin TB1.9).

Pin TB1.7 Tap-Changer Raise Output
This switched output connects the tap-changer raise winding to the source of the motor power (Pin TB1.4). When the controller initiates a raise command, it is capable of switching up to 6 A at 120/240 VAC.

Pin TB1.8 Tap-Changer Lower Output
This switched output connects the tap-changer lower winding to the source of motor power (Pin TB1.4). When the controller initiates a lower command, it is capable of switching up to 6 A at 120/240 VAC.

Pin TB1.9 +12 V DC Wetting Voltage
This is the output of an unregulated DC power supply internal to the controller. It is referenced to neutral and can supply up to 100 mA. It is used for powering the digital inputs of the controller through external relays. Depending on the voltage supplied to Pin TB1.1 and loading, its output can vary from +10 to +18 V dc. It is not fused in the controller.

**CAUTION!**

The M-0280 analog controller that may have been here before could have had a 120 VAC wetting voltage at wire N9. Be sure to disconnect and secure this wire away from the TC250-80 panel.

Pin TB1.10 Operations Counter
This digital input registers the counter contact closure. The operation counter will increment when Pin TB1.10 is grounded via the tap-changer dry contact. The input is level-sensitive. Make sure that any "wetting" voltages are removed from the counter contacts before installing the TC250-80 adapter panel (with TAPCON®250).

**WARNING!**

Risk of electric shock!
+12 VDC or 120 VAC must not be applied to this terminal.

Pin TB1.11 Auto Tap-Change Inhibit
Auto tap-change inhibit is invoked by closing and maintaining a contact connected to this input and to the nominal +12 VDC wetting source (Pin TB1.9). As long as this contact is closed, the tap-changer will not time out, thereby prohibiting raise and lower commands. After opening this contact all timers are reset and the controller starts with normal operation again except in case of a voltage level change (see BA 297 for detailed information).

Pin TB1.12 Alternate Voltage Level #2
Typically, the nominal +12 VDC (Pin P2.10) wetting source enables this digital input through an external contact. The amount of alternate voltage implemented is determined by the setting in the Parameter => Regulation menu.

Pin TB1.13 Circulating Current Return
Bridged with pin TB1.14

Pin TB1.14 Circulating Current Polarity
Bridged with pin TB1.13

Pins TB1.15 & TB1.17 User-Programmable Alarm
This pair of terminals is an alarm relay contact rated for 6 A at 120 VAC. This alarm indicates when any of eight programmable alarm conditions are detected.

Pins TB1.16 & TB1.18 Self-Test Alarm
This pair of terminals is a held-open alarm relay contact rated for 6 A at 120 VAC. Failure of the power supply or the microcontroller results in loss of power to the alarm relay, allowing the contact to close.

**CAUTION!**

Enabling both alternate voltage levels #2 and #3 inputs simultaneously will result in the level of alternate voltage as specified on the alternate voltage #4 setting in the Parameter => Regulation menu.

**NOTE!**

Enabling both alternate voltage levels #2 and #3 inputs simultaneously will result in the level of alternate voltage as specified on the alternate voltage #4 setting in the Parameter => Regulation menu.

**CAUTION!**

The M-0280 analog controller that may have been here before could have had a 120 VAC wetting voltage at wire N9. Be sure to disconnect and secure this wire away from the TC250-80 panel.

**WARNING!**

Risk of electric shock!
+12 VDC or 120 VAC must not be applied to this terminal.
4 Appendix

4.1 TC250-80 Panel and Chassis Front and Side View
4.2 TC250–80 Panel and Chassis Rear View
4.3 TC250–80 Panel Cutout for Surface Mounting

Dimensions are in inches

TC250–80 Panel Cutout for Surface Mounting
4.4 TC250–80 Panel only Side and Front View
4.5 Circuit Variation 1
4.6 Circuit Variation 2
4.7 Circuit Variation 3
4.8 Circuit Variation 4